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METHOD FOR MANUFACTURING A LIQUID CRYSTAL DISPLAY

VERIFYING DECLARATION

Honorable Commissioner For Patents
Washington, D.C. 20231

Sir:

I, Young-ju Lee, declare and say:
(print name of translator)

that I am thoroughly conversant in both the Korean and English languages;

that I am presently engaged as a translator in these languages;

that the attached document represents a true English translation of the Korean Application No. **95-62170**, filed December 28, 1995.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed this 1st day of June, 2001.

Youngju Lee
(signature of translator)

SPECIFICATION

[Title of the Invention]

Method For Manufacturing Liquid Crystal Display

[Brief Description of the Drawings]

FIGS. 1 through 4 are sectional views illustrating a conventional method for manufacturing a liquid crystal display (LCD).

FIG. 5 is a plan view of a LCD according to the present invention.

FIGS. 6 through 11 are sectional views illustrating a method for manufacturing a LCD according to the present invention.

[Detailed Description of the Invention]

The present invention relates to a method for manufacturing a liquid crystal display, and more particularly, to a method for manufacturing a liquid crystal display through reduced number of mask processes.

A variety of plane screens or flat-panel display devices, such as a liquid crystal display (LCD) and a plasma display panel (PDP), have been replaced for conventional comparative bulky cathode-ray tubes (CRT) in order to satisfy the requests for space-saving and personalization of display device that interfaces a computer (including other computerized machines) and a user. Among flat-panel display devices, the LCD is currently the most widely used. For a certain LCD, its color picture quality is comparable with or better than that of CRT.

FIGS. 1 through 4 are sectional views illustrating a conventional method for manufacturing a LCD. In FIGS. 1 through 4, reference numerals 'A' and 'B' denote a TFT area and a gate-pad connection area, respectively.

Referring to FIG. 1, a gate electrode (11) is formed by forming a metal film with Al on a substrate (10) and performing a first photolithography process thereon. After forming a photoresist pattern (not shown) on the gate-pad connection area by a second

photolithography process, the substrate 10 is oxidized to form an anode oxide layer 13 on the gate electrode (11) in the TFT area. At this time, the gate-pad connection area is not oxidized.

Referring to FIG. 2, an insulating film (15) is formed on the entire surface of the gate electrode (11) on which the anode oxide film (13) is formed. Then a semiconductor film is formed by depositing an amorphous silicon film and an impurity-doped amorphous silicon film on the entire surface of the substrate (10) on which the insulating film (15) is formed. Thereafter, a semiconductor pattern including an amorphous silicon film pattern (17) and an impurity-doped amorphous silicon film (19), is formed in the TFT area by a third photolithography process.

In FIG. 3, a contact hole is formed in the gate-pad connection area by performing a fourth photolithography on the insulating film (15). Then a source electrode (21a), a drain electrode (21b) and a pad electrode (21c) are formed by depositing a metal such as Cr on the entire surface of the substrate (10) and performing a fifth photolithography. At this time, the impurity-doped amorphous silicon film (19) is also etched and thus a portion of the amorphous silicon film (17) formed on the gate electrode (11) is exposed.

Referring to FIG. 4, after forming a protective film (23) on the entire surface of the substrate 10, a sixth photolithography process is performed to form a contact hole for pixel electrode in a drain electrode 21b and to remove a protective film on the gate-pad connection area.. Indium-thin oxide (ITO) as a transparent electrode material is formed and a seventh photolithography process is performed to form a pixel electrode (25). The protective film (23), which is formed on the drain electrode through the sixth photolithography process, is etched so that the drain electrode (21b) is connected with the pixel electrode (25).

As describe above, the conventional method for manufacturing the LCD needs at least seven photolithography processes and therefore the manufacturing cost increases and the manufacturing yield also becomes lower.

It is an object of the present invention to provide a more efficient method of

manufacturing a liquid crystal display (LCD) in which a problem associated with contact resistance in a gate-pad connection area can be solved and the number of photolithography processes required is also reduced.

To achieve the above object of the present invention, there is provided a method for manufacturing a liquid crystal display having a TFT area and a gate-pad connection area, comprising the steps of: forming a first metal film on the entire surface of a substrate; forming a second metal film on the first metal film; forming a gate electrode by performing a first photolithography on the second metal film and the first metal film; (d) forming an insulating film and a semiconductor film on the entire surface of the substrate on which the gate electrode is formed; forming a semiconductor pattern layer by performing a second photolithography on the semiconductor film; forming a third metal film on the entire surface of the substrate on which the semiconductor pattern layer is formed; forming a source electrode and a drain electrode in the TFT area, and a pad electrode in the gate-pad connection area by performing a third photolithography on the third metal film and the semiconductor pattern layer; forming a protective film on the entire surface of the substrate on which the source electrode, the drain electrode, and the pad electrode are formed; forming a protective pattern, by performing a fourth photolithography on the protective film and the insulating film, through which the surface of the drain electrode, and gate electrode and pad electrode, which are formed in the gate-pad connection area, is exposed; exposing the surface of the first metal film in the gate-pad connection area by etching the second metal film using the protective pattern as an etching mask; and forming a pixel electrode which is connected to the drain electrode and by which the pad electrode and the gate electrode are connected.

It is preferable that the first metal film and second metal film are formed of Cr, Al or Al alloy. Preferably, the LCD manufacturing method further comprises a step of forming a refractory metal after forming the first metal film. The first and second metal films may be formed through continuous processes. Preferably, the first metal film is formed to be wider than the second metal film.

The semiconductor film may be formed as double films of an amorphous silicon film and an impurity-doped amorphous silicon film.

According to the present invention, a large-sized liquid crystal display can be manufactured at lower cost only through five or six photolithography processes, which is less than those performed in the conventional method.

The embodiment of the present invention will be described in greater detail with reference to the attached drawings.

FIG. 5 is a plan view of a LCD according to the present invention. Referring to FIG. 5, a gate line (gate: 1) is formed in the horizontal direction and a gate pad (3) connected to the gate line (1) is formed. A thin film transistor (5) and a pixel electrode (7) are connected to the gate line (1). A data line (8) is formed in the vertical direction and a data pad (9) connected to the data line (8) is formed.

FIGS. 6 through 11 are sectional views illustrating a method for manufacturing the LCD according to the present invention. In FIGS. 5 through 11, reference characters C and D denote a TFT area and a gate-pad connection area, respectively.

In FIG. 6, a first metal film (31) is formed of Cr, Al or Al alloy on a substrate (30). Thereafter, a second metal film (33) is formed of Cr, Al or Al alloy on the first metal film 31. The first and second metal films (31, 33) can be formed consecutively. After the first metal film 31 is formed, a refractory metal film may be further formed. Then, a gate electrode is formed by performing a first photolithography on the first and second metal films (31, 33). The first metal film (31) is wider than the second metal film (33).

In FIG. 7, an insulating film (35) is formed of a nitride film or an oxide film on the entire surface of the substrate (30). A semiconductor film is formed by continuously depositing an amorphous silicon film and an impurity-doped amorphous silicon film on the entire surface of the substrate (30) on which the insulating film (35) is formed. The insulating film (35) is formed to a thickness between 2000Å and 9000Å, the amorphous silicon film is formed to a thickness between 1000Å and 4000Å and the impurity-doped amorphous silicon film is formed to a thickness between 300Å and 1000Å. Then a semiconductor pattern including an amorphous silicon pattern (37) and an impurity-

doped amorphous silicon pattern (39) is formed in the TFT area by performing a second photolithography on the semiconductor film.

In FIG. 8, a third metal film is formed of Cr, Al, Ta, or Ti on the entire surface of the substrate (30) on which the semiconductor pattern layer and the insulating film (35) are formed. Next, a source electrode (41b) and a drain electrode (41c) are formed in the TFT area and a pad electrode (41a) is formed in the gate-pad connection area by performing a third photolithography on the third metal film. At this time, the impurity-doped amorphous silicon film (39) in the TFT area is etched and therefore, the amorphous silicon film (37) is exposed.

In FIG. 9, a protective pattern (43) is formed on the entire surface of the substrate (30) by forming a protective film with a nitride film or the like and performing a fourth photolithography on the protective film. At this time, a portion of the protective film on the drain electrode (41c) in the TFT area is etched. The insulating film (35) formed on the gate electrode, i.e., the second metal film (33) thereof, in the gate-pad connection area is etched, so that the surface of the gate electrode is exposed. A portion of the protective film on the pad electrode (41a) is etched.

In FIG. 10, the second metal film (33), which is positioned at the gate electrode-pad connection area indicated as reference numeral '45' and is exposed through the protective film pattern (43), is etched. As a result, contact resistance between a pixel electrode and the second metal film (33) can be reduced in a subsequent process.

In FIG. 11, a pixel electrode (47) is formed by depositing a transparent electrode material, such as indium-tin oxide (ITO), on the entire surface of the substrate (30) on which the protective film pattern (43) is formed and performing a fifth photolithography on the ITO. As a result, the drain electrode (41c) and the pixel electrode (47) are connected in the TFT area, and the gate electrode consisting of the first metal layer (31) and second metal layer (33) and the pad electrode 41a are connected by the pixel electrode 17 in the gate-pad connection area.

As described above, the method for manufacturing a liquid crystal display according to the present invention can form double gate electrodes through five or six

lithography processes, so that the manufacturing cost can be remarkably reduced and the manufacturing yield can be improved, compared to the conventional method in which seven photolithography processes are applied.

Also, it is possible to suppress the growth of a hillock of the Al film due to stress relaxation effect of the chromium and Al films formed as double gate electrodes.

As shown in FIG. 10, it is possible to reduce the contact resistance between the Al film of the gate electrode and the pixel electrode to be formed in a subsequent process by etching the Al film in the gate-pad connection area, prior to forming the gate electrode.

While this invention has been particularly shown and described with reference to preferred embodiments thereof The present invention is not restricted to the above embodiments, and it is clearly understood that many variations can be possible within the scope and spirit of the present invention by any one skilled in the art.

What is claimed is:

1. A method for manufacturing a liquid crystal display having a TFT area and a gate-pad connection area, comprising the steps of:

(a) forming a first metal film on the entire surface of a substrate;

(b) forming a second metal film on the first metal film;

(c) forming a gate electrode by performing a first photolithography on the second metal film and the first metal film;

(d) forming an insulating film and a semiconductor film on the entire surface of the substrate on which the gate electrode is formed;

(e) forming a semiconductor pattern layer by performing a second photolithography on the semiconductor film;

(f) forming a third metal film on the entire surface of the substrate on which the semiconductor pattern layer is formed;

(g) forming a source electrode and a drain electrode in the TFT area, and a pad electrode in the gate-pad connection area by performing a third photolithography on the third metal film and the semiconductor pattern layer;

(h) forming a protective film on the entire surface of the substrate on which the source electrode, the drain electrode, and the pad electrode are formed;

(i) forming a protective pattern, by performing a fourth photolithography on the protective film and the insulating film, through which the surface of the drain electrode, and gate electrode and pad electrode, which are formed in the gate-pad connection area, is exposed;

(j) exposing the surface of the first metal film in the gate-pad connection area by etching the second metal film using the protective pattern as an etching mask; and

(k) forming a pixel electrode which is connected to the drain electrode and by which the pad electrode and the gate electrode are connected.

2. The method as claimed in claim 1, wherein the first metal film and the second metal film are formed of Cr, Al or Al alloy.

3. The method as claimed in claim 1, further comprising a step of forming a refractory metal layer after forming the first metal film.

4. The method as claimed in claim 1, wherein the first metal film and the second metal film are formed through continuous processes.

5. The method as claimed in claim 1, wherein the first metal film is formed to be wider than the second metal film.

6. The method as claimed in claim 1, further comprising a step of anode oxidation after forming the gate electrode.

7. The method as claimed in claim 1, wherein the semiconductor film is formed as double films consisting of an amorphous silicon film and an impurity-doped amorphous silicon film.

ABSTRACT

A method for manufacturing a liquid crystal display (LCD), which reduces the number of the mask processes, is provided. In the method for manufacturing an LCD having a TFT area and a gate-pad connect area, a gate electrode is formed as double layers including a first metal film and a second metal film, and a second metal film located in the gate-pad connect area is etched so that the first metal film and a pad electrode are connected by a pixel electrode. Therefore, it is possible to manufacture a large-sized LCD through reduced number of photolithography processes, e.g., through five photolithography processes, at low cost.

[Representative Drawing]

FIG. 11

FIG. 1

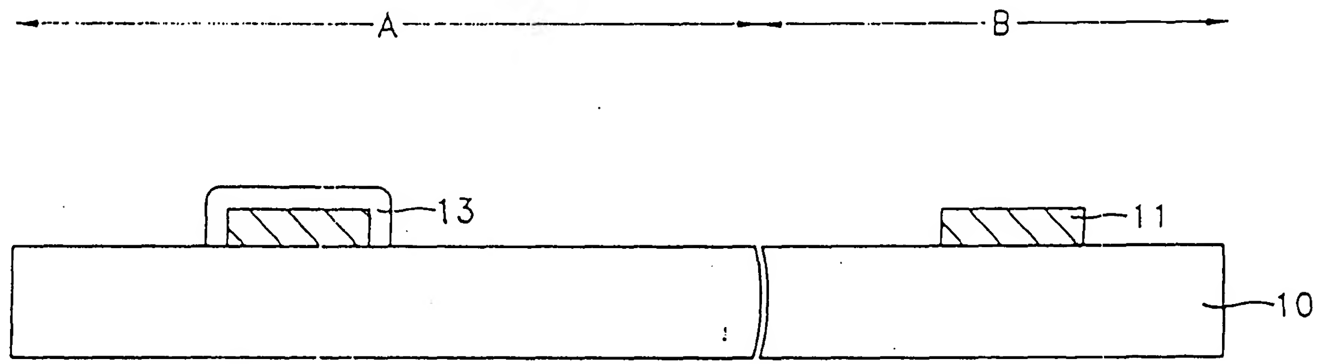


FIG. 2

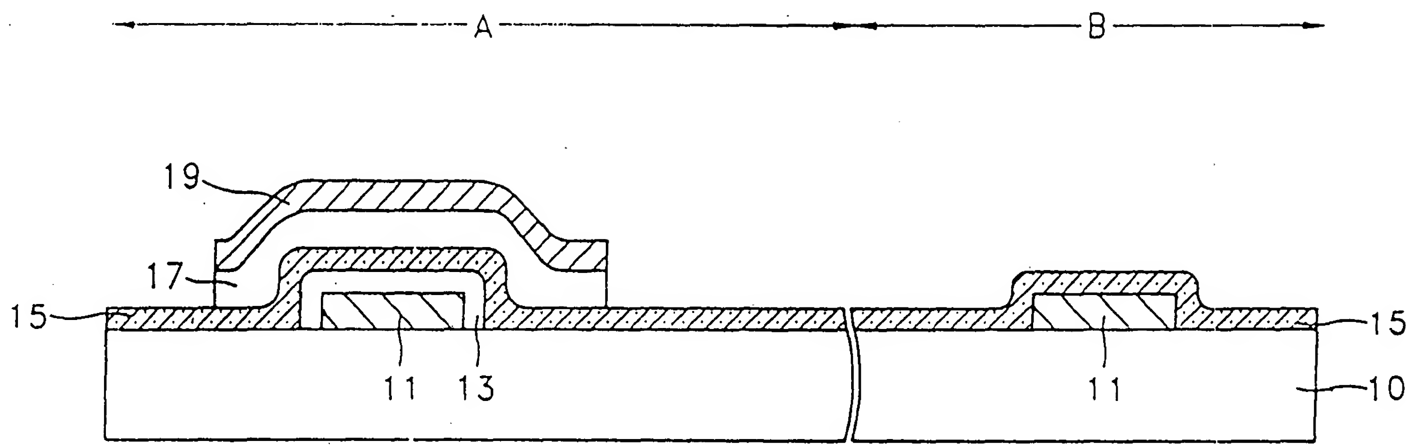


FIG. 3

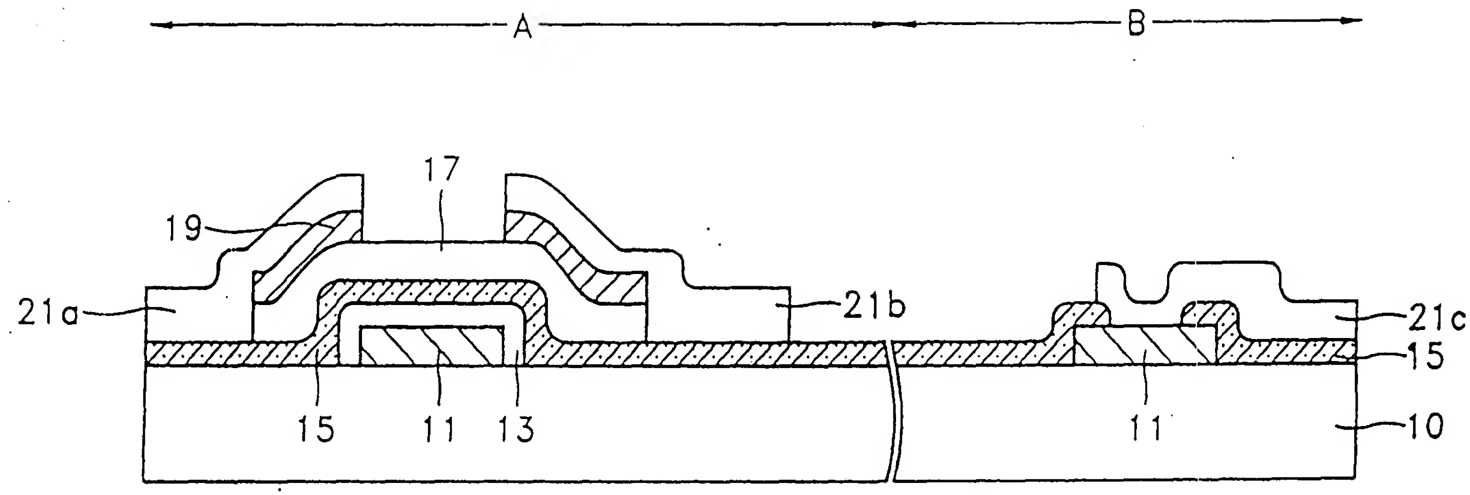

A
B
17
19
21a
21b
21c
15
15
11
13
11
10

FIG. 4

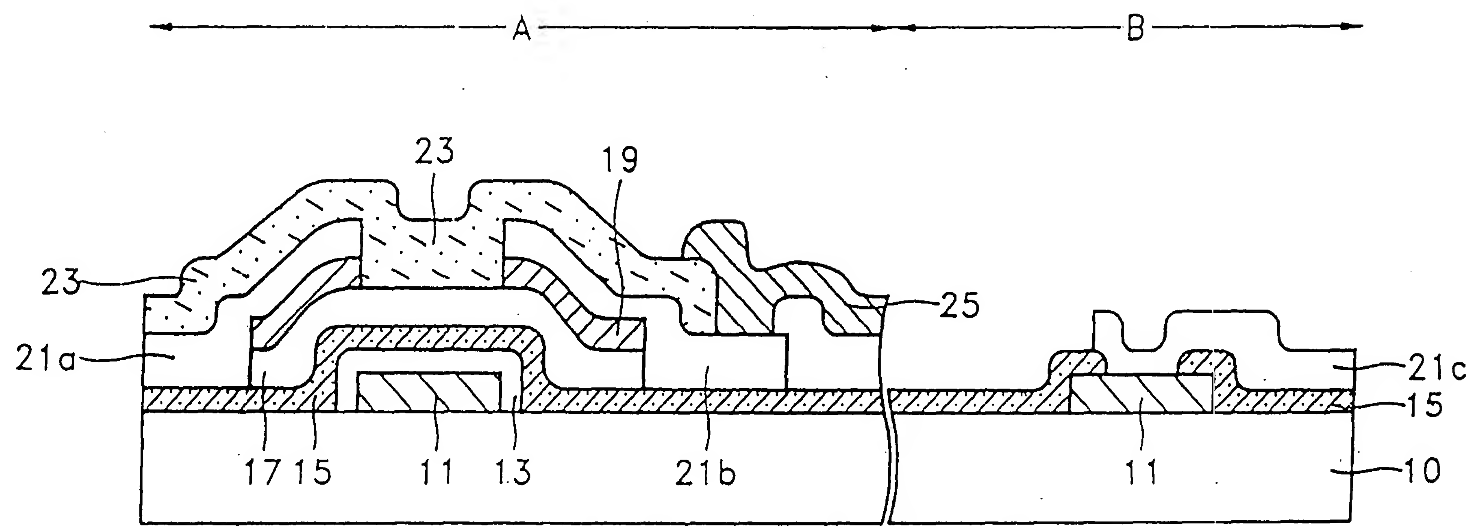

A
B
23
19
23
25
21a
21c
15
17
15
11
13
21b
11
10

FIG. 5

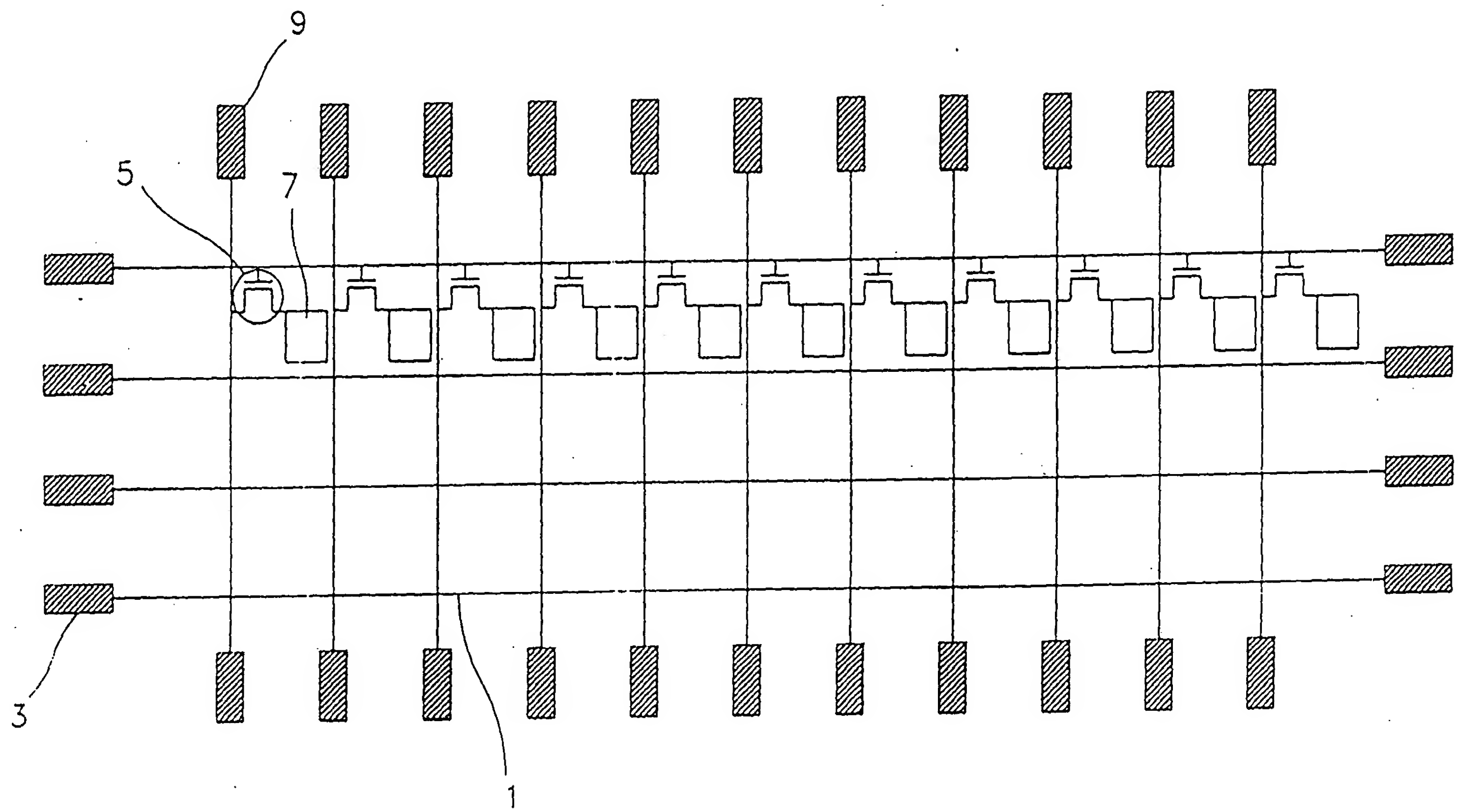


FIG. 6

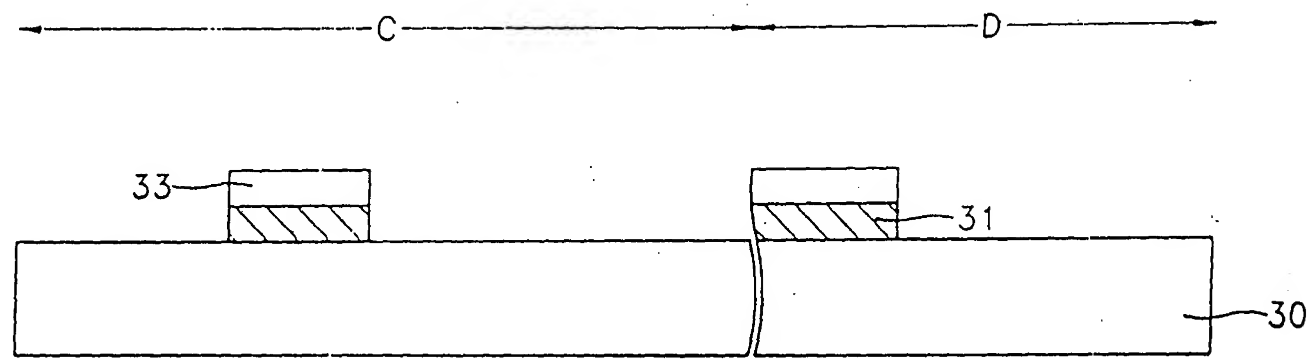


FIG. 7

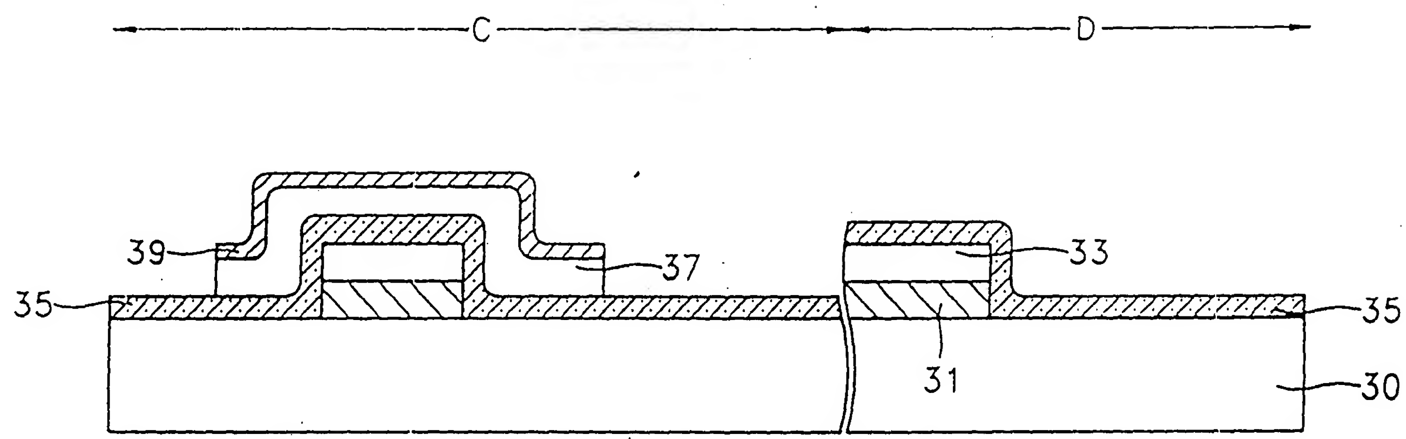


FIG. 8

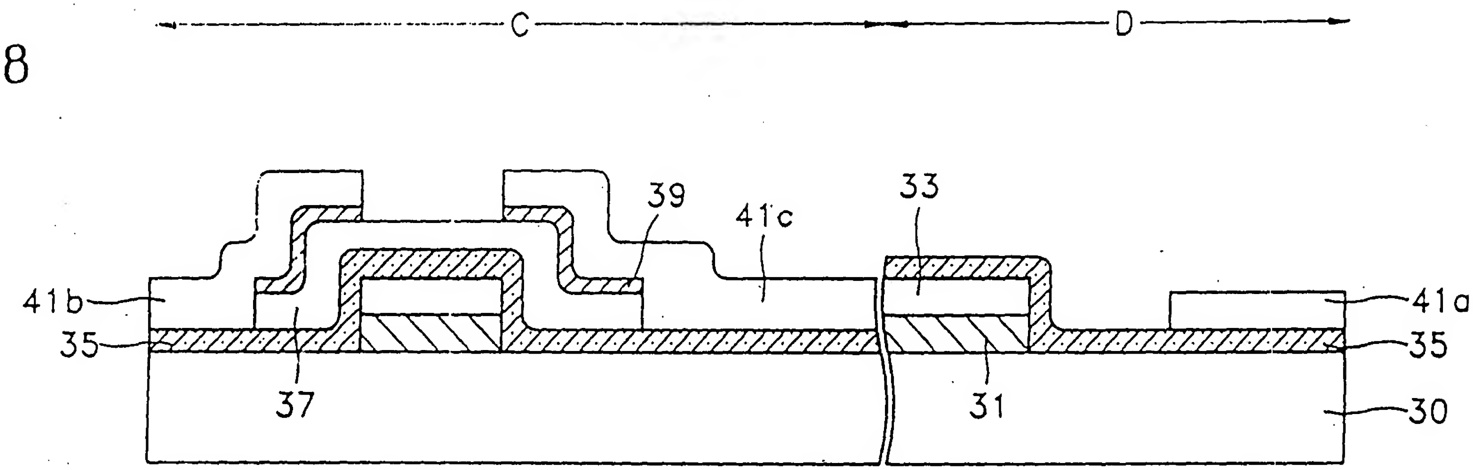

C
D
39
41c
33
41b
35
37
31
41a
35
30

FIG. 9

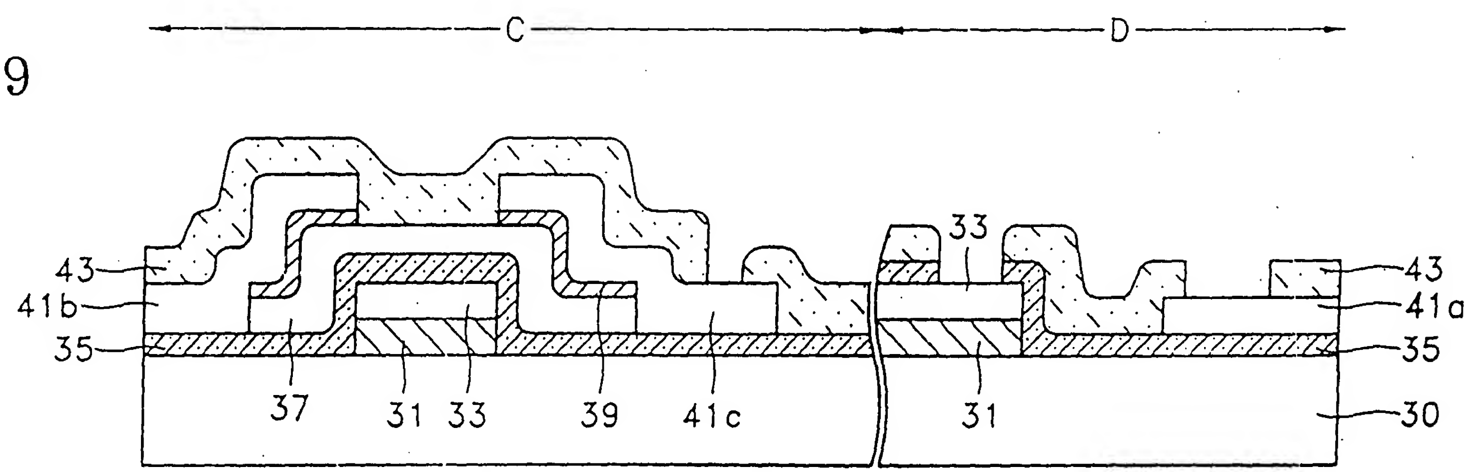
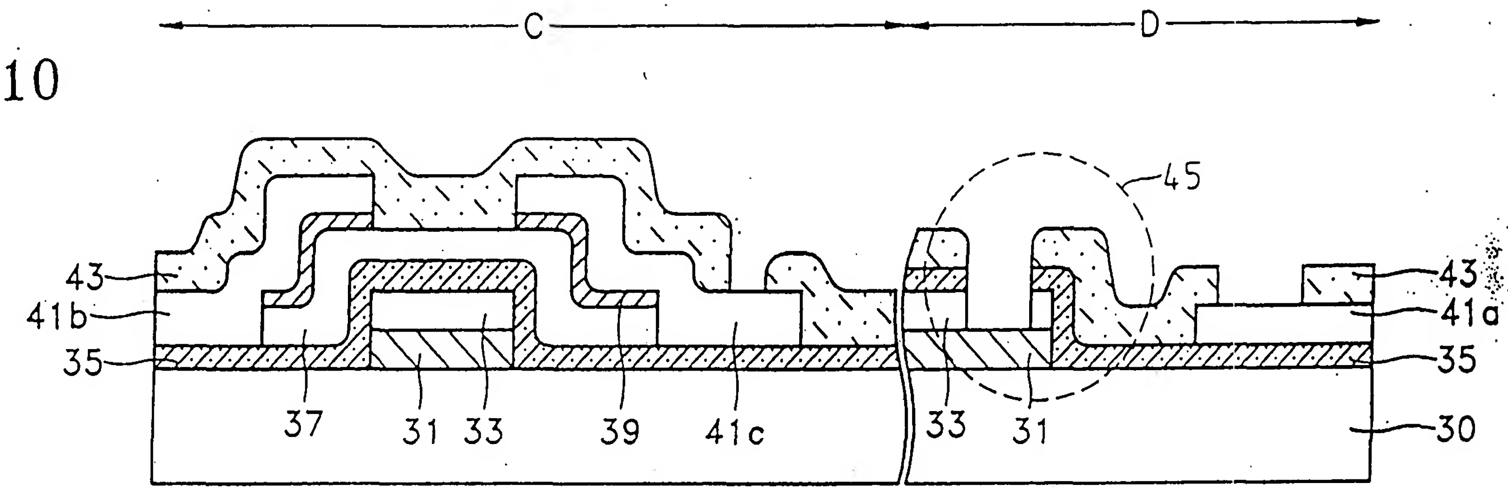

C
D
33
43
41b
35
37
31
33
39
41c
31
43
41a
35
30

FIG. 10


C
D
45
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41b
35
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31 33
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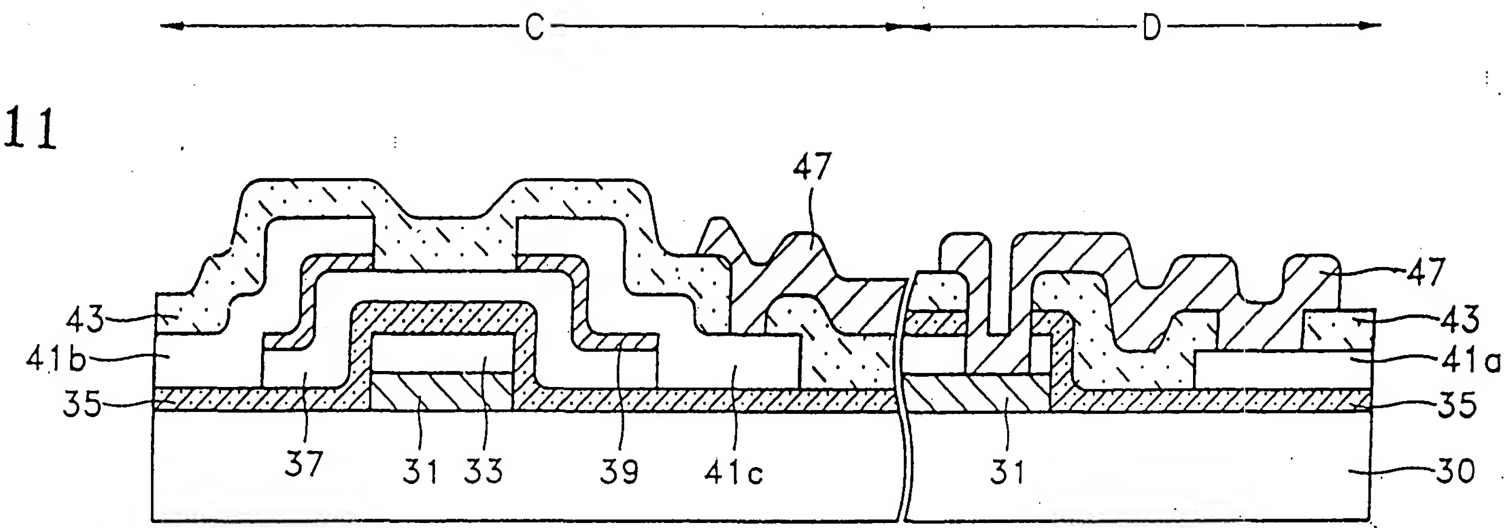
41c
33
31
43
41a
35
30

FIG. 11


C
D
47
43
41b
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31 33
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41c
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41a
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30